



Memorandum of Understanding

Between

International Virtual-Data Grid Laboratory and the US CMS Software and Computing Project

<date signed>

1. Introduction

This Memorandum of Understanding (MOU) describes the collaboration between the International Virtual-Data Grid Laboratory (iVDGL), also referred as the laboratory, and the United States Compact Muon Solenoid Software and Computing (USCMSSC) project to conduct high-energy physics research using the CMS detector at the Large Hadron Collider (LHC) at CERN. The purpose of this collaboration is the design, deployment, and operation of the prototype Tier-2 regional computing facilities and the deployment and integration of grid-enabled software needed by the CMS detector at the Large Hadron Collider (LHC) at CERN. The detector is described in the CMS Technical Proposal, December 15, 1994, the Technical Design Reports, and subsequent technical documents elaborating that design. Requirements for software and computing, including the USCMSSC work plan for prototyping the Tier-2 regional computing facilities, are described in the USCMS Software and Computing Project Plan and associated Work Breakdown Structure (WBS). The contribution of the USCMSSC collaboration to the CMS Project is defined by the scope of work determined by these documents.

USCMSSC plans to use iVDGL as part of the CMS production scale, grid enabled distributed environment in which CMS grid-based software can be prototyped, developed, refined, and evaluated, and optimized to simulate and produce data and conduct physics analysis at Tier-1, Tier-2, and possibly Tier-3 centers, as described in the NSF proposal for iVDGL [1]. This work will be performed as part of the USCMSSC User Facilities (UF) subproject, as explained in the USCMS Software and Computing Project Management Plan [2], which is collaborating with the CERN LHC Computing Grid (LCG) project [3] and LHC regional centers around the world to deliver the distributed Grid-based computing environment for LHC physics research. The work by iVDGL of providing a robust grid enabled environment for USCMSSC encompassing two prototype Tier-2 centers forms the basis of this MOU.

The USCMSSC project management infrastructure and the project office reside at Fermilab. The USCMSSC project manager (PM) is responsible for USCMSSC project management and

reports to the USCMSSC Project Management Group (PMG). As a part of the UF subproject, a Level-3 project manager will be assigned by the USCMSSC PM) for each prototype Tier-2 center. This person is responsible for managing operations at the CMS iVDGL site on behalf of the USCMSSC project.

This Memorandum of Understanding describes the long-term contributions of iVDGL to achieve objectives for computing infrastructure of USCMS Tier-1 and Tier-2 prototype centers. USCMSSC has chosen the sites hosting prototype Tier-2 centers for CMS in the US following a bidding procedure [3] as agreed to by the US CMS collaboration and project oversight at Fermilab. The host sites chosen are California Institute of Technology and University of California at San Diego for the first prototype and the University of Florida for the second prototype Tier-2 center.

Those institutions form the USCMS institutions in the iVDGL. The construction of USCMS prototype Tier-2 centers at these institutions is already a part of the USCMSSC WBS. Upon the approval of this MOU, USCMSSC WBS will be modified to reflect any additional tasks to be performed by iVDGL. It is understood that these tasks may later be modified or that additional responsibilities may be added. This MOU shall remain effective to the end of FY2004. The USCMSSC project finishes at the end of FY2007.

This Memorandum of Understanding also describes the contribution of the USCMSSC project to global tests and demonstrations of the iVDGL together with other participants of the iVDGL collaboration ("Lab operations"). This work will be conducted under the leadership of iVDGL work teams, as defined in the iVDGL management plan [4] and in the iVDGL project plan [5]. It is expected that "Lab operations" does not exceed 10-20% of the available efforts at the prototype Tier-2 centers. These activities need to be agreed with the USCMSSC PM who will take into account both the work plans of iVDGL and the work plans of USCMSSC.

1.1 Makers of the MOU

This Memorandum of Understanding is made between the iVDGL and the USCMSSC project. Fermilab is a signatory to this MOU as part of its role in USCMSSC management oversight. The institutions, that host prototype Tier-2 centers and related efforts, are also part of this MOU. It does not constitute a legal, contractual obligation on the part of any of the parties. It reflects an arrangement that is currently satisfactory to the parties involved. The parties agree to negotiate amendments to this memorandum as required.

1.2. Statement of Work

This MOU will be supplemented by separate annual Statements of Work (SOWs) between USCMSSC and each USCMS institution involved in the iVDGL.

The SOW will detail specific activities to be accomplished by that USCMS institution in iVDGL against the planned requirements established in the USCMS WBS in terms of personnel and equipment. It will detail the funds allocated to that institution from the iVDGL and the funds to be allocated from the USCMSSC project. The SOW will also address the specific list of personnel and equipment and any redirection of the project. The normal period of performance will be the US

fiscal year (October 1 - September 30). If additional funding becomes available to iVDGL or to USCMSSC to conduct work for the USCMSSC project, associated SOWs and their changes related to scope, cost and invoicing mechanism must be pre-approved by the USCMSSC PM. The annual SOW shall be approved by the USCMSSC PM at least two months before the beginning of the fiscal year.

2. Personnel

2.1. *List of Scientific Personnel for USCMS institutions*

Participating scientists committed to USCMSSC over the full project period are listed below, separately for each participating institution. No support for these individuals may come from project funds. Paul Avery from University of Florida is the Principal Investigator (PI) and lead scientific contact for USCMSSC at iVDGL. Ian Foster of University of Chicago is the alternate PI for the iVDGL. Harvey Newman and James Branson are the lead contact persons for Caltech and UCSD respectively. Lothar Bauerdick at Fermilab is the PM for USCMSSC.

2.2. *List of Technical Personnel*

Participating technical personnel from each USCMS institution in iVDGL, the anticipated fraction of their time committed to the support of USCMSSC and their source(s) of support will be detailed in the annual SOW with the USCMS iVDGL institutions. The level of work assumed for the USCMSSC project (1 FTE = 250 days) by physicists, engineers and technicians at each USCMS iVDGL, throughout the life of the project is given below. The cost related to the USCMSSC project will be assigned algorithmically in the case of a grant supplement.

USCMS iVDGL Institution	Technical contact
U. of Florida	Jorge Rodriguez
UCSD	Ian Fisk
Caltech	Julian Bunn

2.3. *List of Financial Personnel*

Institution	Name
U. of Florida/iVDGL laboratory	?
UCSD	?
Caltech	Richard Seligman

3. **Prototype Tier-2 Facilities, Design, Deployment and Support Responsibilities**

3.1. Estimated Cost and Deliverable

The USCMSSC WBS, including its future modifications, contains a detailed cost estimate of the items needed to complete the USCMSSC project. By this MOU, iVDGL and the USCMS institutions in iVDGL agree to make a best effort to provide items assigned at a cost not to exceed the WBS base cost estimate. Procedures to be followed in the event of a necessary variation of cost from the base cost are described in section 3 below. The current description of high level tasks and budget allocation of funding for USCMS institutions is given in Appendix A. Yearly SOWs will contain detailed definitions of the tasks and efforts. It should be noted that this funding profile constitutes a large fraction of resources needed for USCMS prototype Tier-2 centers, making iVDGL a high-risk component of the USCMSSC project.

3.1.1. Operations of Facilities, Release, Deployment & Documentation

The iVDGL and the USCMS iVDGL institutions shall be responsible for assuring the operation of the USCMS prototype Tier-2 computing facilities and for assuring acceptable deployment of CMS specific and Grid related software packages at those facilities. That includes system administration and installation, maintenance, verification and local site support for grid middleware, authorization, authentication and accounting infrastructure. Working with the USCMSSC UF engineers, all CMS related software products should be deployed by iVDGL in a timely manner. The laboratory agrees to provide round the clock support for the system for the duration of the project. The laboratory agrees to provide a high level of reliability and availability for the system. Any outage or abrupt maintenance shutdown shall be recorded and analyzed to minimize future disruptions. Adequate notices must be given to the USCMSSC UF engineers for routine maintenance and upgrades.

USCMSSC agrees to install appropriate stable software produced and recommended by iVDGL at its Tier-1 and Tier-2 centers to conduct iVDGL inter-experiment activities, as agreed between the USCMSSC PM and the iVDGL. However, USCMSSC reserves the right to refuse installation of versions or components of software if they are deemed to be unfit for use by the USCMSSC PM. USCMSSC PM will provide such refusals to the management of the laboratory in writing. When installing new software, the laboratory should use availability of adequate user documentation as a precondition for installation.

Unless specifically indicated otherwise, any software products developed by iVDGL shall be released following a standard release mechanism. The iVDGL will use the Virtual Data Toolkit (VDT) as the standard deployment mechanism for software releases, specifically Grid Middleware.

The official release of the VDT software shall be tested using adequate verification and validation procedures including testing of USCMS interfaces. The laboratory, through the VDT, shall be responsible for providing well-documented user guides and programmer guides. Delivery of the adequate documentation shall be a precondition of an official release. The laboratory, through the VDT, shall be responsible for maintaining a formal trouble reporting system that can be accessed by USCMSSC personnel to report, track, and close the USCMSSC support issues. The laboratory,

through the VDT, shall publish timely guidance on various software compatibility issues and hardware upgrade requirements.

3.1.2. Testing, Installation, Commissioning, Integration, Support and Monitoring

The iVDGL and the USCMS iVDGL institutions shall make a coherent effort on participating in the testing, installation, maintenance, and monitoring processes. To minimize adverse impact to the USCMSSC activities, the laboratory shall make every effort to install stable hardware and software that underwent adequate verification and validation testing including those of USCMS interfaces. Adequate test plans shall be used during commissioning. The laboratory shall provide appropriate priorities to install and support versions of software used by CMS experiment. Test reports shall be made available.

Working with the USCMSSC UF engineers, the laboratory shall assure the following, as necessary:

- Maintenance and management of grid certificates
- Maintenance of grid catalogs and metadata catalogs and associated repositories
- Planning, submitting, staging, running and publishing of jobs
- Resource planning and monitoring of disk /farm spaces, backups and mass storage spaces

The laboratory will implement a robust problem reporting, tracking and resolution system for grid enabled hardware and software, relevant to the USCMS user facilities. The laboratory will institute a 24/7 support mechanism to assist USCMS grid users.

The laboratory shall institute and maintain a well-designed performance monitoring program for reliability, availability and maintainability of the grid when deploying CMS computing tasks. The laboratory will participate, on behalf of USCMSSC, in the demonstration of the grid enabling capabilities of the computing infrastructure as necessary.

3.1.3. Configuration Management

The iVDGL and the USCMS iVDGL institutions shall institute a formal hardware and software configuration management system. Through the VDT, the laboratory shall maintain an easily accessible software repository for the deployment of grid enabling software at various USCMS centers. The laboratory shall track software requirements (e.g. use cases or requirements embedded in WBS) and their final implementation. The configuration of the hardware and software infrastructure shall be documented and published by the laboratory.

3.2. Coordination and Reporting

The USCMSSC PM is a signatory to this MOU. The iVDGL contact person for USCMSSC activities is Paul Avery of University of Florida. The task manager for USCMSSC activities carried out at the prototype Tier-2 centers are the USCMSSC level-3 managers assigned by the USCMSSC PM.

The technical progress on deployment, evaluation and optimization of the prototype Tier-2 center facilities and software systems and on test runs like data challenges and iVDGL test runs will be reported by the above-named task managers to the USCMSSC PM. The PM will, in turn, report to the Fermilab PMG. Technical reporting to CMS project management and funding agencies shall be performed by the USCMSSC PM.

The laboratory agrees to furnish complete documentation of the quality control and performance testing which are carried out for USCMSSC.

Any changes to the scope of the project and the associated cost must be documented and pre-approved by USCMSSC PM using the change control mechanism established by the USCMSSC project office. Changes to the annual SOW shall be managed by the USCMSSC project office.

3.3. Procurement Authorization

The USCMSSC PM delegates obligation authority regarding the designated WBS items in the SOW to the authorized financial officer at the corresponding USCMS iVDGL institution subject to the following requirements. The base cost of the WBS items is given in the SOW without contingency. The officer agrees that these cost ceilings cannot be exceeded without the authorization the PM. In addition, the officer agrees that item purchases exceeding the delegated limit (currently 10 k\$) must be authorized by the USCMSSC PM.

Major procurements (currently greater than or equal to 50 k\$) must in addition have the written authorization of the USCMSSC PM.

3.4. Financial Reporting to USCMSSC Project Management

The funding allocated to USCMS iVDGL institutions shall be tracked in terms of effort reporting by FTE and equipment cost. Each USCMS iVDGL institute will assign an individual to be responsible for the financial reporting. The institute will report all USCMSSC related expenditures and labor charges together with associated technical progress in each item of work by WBS category (lowest level) covered in the Statement of Work regardless of the specific nature of the funding support. This detailed reporting will be done on a quarterly basis to the USCMSSC PM. Any request for variance from the base cost must be immediately reported to the PM. Any significant variance in schedule from the base schedule must be immediately reported to the USCMSSC PM.

The USCMS iVDGL institution agrees, with this document, to set up and maintain a ledger of a form compatible with the one used by USCMSSC project management. It also agrees to provide and maintain this ledger so as to provide timely information to the USCMSSC project office.

3.5. Collaboration with Other Groups and Institutions

Decisions related to design, development and installation of hardware and software related to USCMSSC will be carried out in close communication and collaboration with other groups involved

in USCMS UF, the LCG project and other collaborating grid projects. The USCMSSC PM will be solely responsible for communicating such decisions to the CMS Computing and Core Software (CCS) project and the LHC Computing Grid Project at CERN. The iVDGL and the USCMS institution agree to monitor critical paths in the USCMSSC delivery schedule and address issues related to them in a timely manner.

4. Contribution of the primary host institution for iVDGL

University of Florida is the primary host institution for the USCMS effort in iVDGL. Subject to adequate funding by the NSF, the primary host institution of the iVDGL will provide support for the scientific and technical personnel as indicated in section 2 during this period of performance. By this MOU, the primary host institution agrees to provide the services of the responsible financial officer. Standard practices used by the primary host institution for the laboratory for cost accounting will be applied to the USCMSSC project activities at USCMS institutions in iVDGL.

4.1. Effort

Subject to adequate funding by the NSF and the DOE, each USCMS institution in iVDGL will provide support for the scientific and technical personnel as indicated in section 2. This contribution refers only to support provided outside the USCMSSC budget allocation.

4.2. Services

The support services of USCMS institutions in iVDGL will be available to the USCMSSC project to the degree required to carry out the responsibilities of the institution.

4.3. Facilities and Equipment

Facilities and equipment of USCMS institutions in iVDGL will be made available to the USCMSSC project to the degree necessary to carry out the design, implementation and testing responsibilities of the group.

4.4. Operating Costs

The USCMS institutions in iVDGL, subject to the availability of funds from the NSF, will support the normal research operating expenses (such as physicists' salaries, travel expenses, miscellaneous supplies, administrative support, etc.) of the CMS groups working on the USCMSSC and iVDGL project. Tracking of the cost associated with USCMSSC project, whether provided by the USCMS institution in iVDGL or paid by the USCMSSC project, will be done using appropriate effort reporting codes.

5. Costs and Funding

5.1. Expected Sources of Funding

The cost of the prototype Tier-2 efforts covered under the USCMSSC WBS is taken from the USCMSSC cost estimate provided in the USCMS Software Project Management Plan [0]. DOE (NSF) Funds indicate the project funds expected to be provided over the lifetime of the project. The iVDGL agrees not to exceed the costs shown in the annual SOW, subject to the procedures given in section 3.3.

5.2. Allocation of Funds

Each year, a SOW will be written with each USCMS institution in the iVDGL for the User Facilities subproject of USCMSSC. Funding for this effort will come from two sources.

1. Funds provided by the NSF to the iVDGL
2. Funds provided by the DOE or the NSF to the USCMSSC project.

The planned allocation for the first part of the funding is given in the Appendix of this MOU. Actual allocation is subject to the decision of the USCMSSC PM within the boundaries of the total funds available to the USCMS part of the iVDGL. The allocation of these funds needs concurrence from the iVDGL PI.

The allocation for the second part is up to decision of the USCMSSC PM and requires concurrence of the chairperson of the USCMSSC PMG.

The allocation of funds to each USCMS institution in the iVDGL for each fiscal year will be in two parts. The first will cover work for the first six months. The remaining funds needed to complete the tasks described in the SOW will be provided subject to availability of funding and performance during the first half-year. Management control requires the review and concurrence of the USCMSSC PM and the Project Office, as needed, for major expenditures, as defined above. The release of funds above the given thresholds by the responsible financial officer as named above will be contingent upon this concurrence.

5.3. Method of Funding Transfers

The expenditures by each USCMS institute in iVDGL are to be covered by funds provided by the NSF to the iVDGL and by the DOE or NSF to the USCMSSC project, upon the allocation decision of the USCMSSC PM with the concurrence of the chairperson of the USCMSSC PMG and the iVDGL PI, as appropriate.

Funds to cover work or expenditures described in this document will be provided by using one or more of the following options:

1. The USCMS institution in iVDGL will enter into a subcontract with the lead institution for the iVDGL. In this case the USCMS institution must obtain pre-approval of the USCMSSC PM for the funds transfer mechanism and invoices. The USCMS institution agrees to make reasonable requests for such accounting information available to the USCMSSC PM and the iVDGL PI.
2. The laboratory may issue invoices against a Memorandum Purchase Order (MPO) to the USCMS institution from the USCMSSC project office at Fermilab,

3. The USCMS institution may enter into a subcontract with the USCMSSC project office at Fermilab.
4. The USCMS institution may enter into a subcontract with the lead NSF institution for the USCMSSC project. In this case, the USCMC institution must obtain pre-approval of the USCMSSC PM for the funds transfer mechanism and invoices. The laboratory agrees to make reasonable requests for such accounting information available to USCMSSC PM.

The choice of funding method shall be at the discretion of the PM. All equipment items bought using DOE or NSF funds will be properly marked as the property of DOE or NSF.

6. General Considerations

The program described in this MOU is a collaborative effort between the laboratory and USCMSSC. Best efforts will be made to accommodate running laboratory tests and iVDGL applications on the facilities at USCMS iVDGL institutions, respecting the requirements of a production quality facility for USCMS. It is expected that the accumulated availability of the facilities for iVDGL purposes would be several weeks per year. These lab test will be scheduled to minimize conflict with the USCMS schedule, and need the approval of the USCMSSC PM.

Quality of services will in general be the same for lab test and production operations. Requirements on specific software and configurations are expected to change during the lifetime of the project and will be accommodated with best effort.

There will be good faith efforts to resolve conflicting requirements as they occur.

6.1. Operations of Facilities

The laboratory, in cooperation with the USCMSSC UF and the USCMS iVDGL institutions, will establish standard system administration procedures. It will maintain adequate trouble reporting and tracking procedures to resolve CMS related issues. Main operation center for iVDGL will maintain high-level of visibility for the CMS project. The laboratory will maintain a strong public information base for CMS activities.

6.2 Software Engineering Practices

Software developers from the laboratory, agree to familiarize themselves with standard software engineering best practices and to adhere to them. All major components will undergo appropriate validation testing. The PI or alternative PI for the laboratory is responsible for assuring software engineering best practices including implementation of software design and coding guidelines.

6.3. Quality Assurance

The laboratory will institute appropriate quality assurance procedures to procure reliable hardware for all USCMS iVDGL facilities. The laboratory agrees to implement adequate level of software quality assurance and software configuration management procedures for software delivered to the USCMS project.

7. Schedules and Milestones

The USCMS institutions in iVDGL will make every effort to carry out their institutional responsibilities consistent with the schedule for the US CMS UF effort. These schedules may have to be changed as the project progresses. The USCMS institution will notify the USCMSSC project office any significant changes to scope, cost and schedule that might affect the USCMSSC project as soon as possible. These changes must be documented in writing and must be approved by the USCMSSC PM. These changes will be documented in the annual SOW. The USCMSSC project milestones over the life of this MOU relevant to the USCMS institution will appear in the annual SOW.

8. References

1. An International Virtual-Data Grid Laboratory for Data Intensive Science, Submitted to the 2001 NSF Information and Technology Research Program Proposal #0122557
USCMS Software and Computing Project Management Plan,
2. LHC Computing Grid Project, lhcggrid.web.cern.ch/LHCgrid/home/main.htm
3. Selection of U.S. CMS prototype Tier-2 regional centers
4. iVDGL management plan
5. iVDGL project plan
6. VDT plan??

Appendix A – Summary of Long Term Budget

,

10. Makers and Concurrence

The following persons concur in the terms of this Memorandum of Understanding. These terms will be updated as appropriate in Amendments to this Memorandum.

Makers of this Memorandum:

Lothar A T Bauerdick (date)
U.S. CMS Software and Computing
Project Manager

Ian Foster (date)
iVDGL Principal Investigator, U. of Chicago

Paul Avery (date)
iVDGL Principal Investigator, U. of Florida

iVDGL Principal Investigator (date)
Administrative and Financial person

Harvey Newman (date)
Caltech

Richard Seligman (date)
Administrative and Financial Person, Caltech

James Branson (date)
UCSD

Administrative and Financial person (date)

Concurrence:

Mike Shaevitz (date)
Associate Director, Fermilab
Chair, USCMSSC Project Management Group

Signed copy sent to:

1. Lucas Taylor, CCS Technical Coordinator
2. Jim Yeck, LHC Project Manager